



**2017 Water Quality Report**  
**Fresh Pond Reservation: Class B Ponds, Cambridge, MA**

The Cambridge Water Department monitors three ponds on the Fresh Pond Reservation: Little Fresh Pond, Black's Nook, and North Pond. Water quality samples from each pond are collected quarterly. These shallow ponds have no surface water connections to the Fresh Pond water supply reservoir, and as such, they have negligible influence over water quality in the Cambridge water supply. Gated pipes between Little Fresh Pond and Fresh Pond Reservoir are kept closed under normal operating conditions, but are opened as needed in controlled conditions to supply irrigation water to Little Fresh Pond. All three ponds drain the City of Cambridge Municipal Golf Course and the reservation's wooded areas, with overflow connections to the City's storm drain system. Stormwater in the developed areas surrounding the reservation is diverted away to further protect drinking water quality. Groundwater communication between the ponds, the surrounding developed area, and the reservoir is minimized by keeping the reservoir higher than the water table.



**Figure 1: Fresh Pond Reservation Waterbodies**



This report includes data from the reporting period of April 1, 2017 to March 31, 2018 (reporting year 2017).

Massachusetts Class B waters are designated for fish, other aquatic life and wildlife habitat, and for primary and secondary contact recreation. Class B water quality standards include numeric and narrative standards for dissolved oxygen, temperature, pH, bacteria, solids, color and turbidity, oil and grease, and taste and odor. In this study period, four dry-weather water quality sampling events were conducted. Samples were taken at the surface of each pond using extended poles or hand-grabbing samples after wading in from the shoreline. *In-situ* parameters were taken with a calibrated multi-probe concurrently with grab samples.

## 2017 Results

**Black's Nook-** Listed in the 2014 Massachusetts Integrated List of Waters as a Category 5 impaired water for secchi disk transparency, nutrient/eutrophication biological indicators, and non-native aquatic plants. Historic and recent chlorophyll-*a* (chl-*a*) results are consistent with Carlson's trophic state index (TSI) for a highly-productive, eutrophic pond. Median and average TSI numbers during reporting year 2017 were in the eutrophic range, although the chl-*a* reading from the February sampling event placed the pond in the mesotrophic zone (figure 2).

### 1. Dissolved Oxygen (DO)

- There was one violation of the Class B standard for dissolved oxygen ( $\geq 5$  mg/L) observed in surface samples during the reporting period. Respiration from microbial organic matter decomposition and algae and plant growth likely contributed to the low DO concentration during the August 2, 2017 summer sampling event.

Date	Time	Result
8/2/17	10:31 am	3.12 mg/L

### 2. Temperature

- No violations associated with warm-water fisheries were observed. Class B standard requires temperatures not to exceed 28.3 °C.

### 3. pH

- No violations observed;  $6.5 < \text{pH} < 8.3$ .



## 2017 Fresh Pond Reservation Class B Waters

### 4. Bacteria

- One *E. coli* sample violated the Class B water quality for bacteria (< 235 colonies/100mL or most probable number (MPN)/ 100 mL for a single sample).

Date	Time	Result
8/2/17	10:31 am	411 MPN/ 100 mL

### 5. Solids

- There are no numeric criteria for solids, but visual observations suggest that neither floating nor suspended solids were an impairment for Black's Nook. However, the eutrophic state and dense aquatic plant growth limit the potential for swimming and boating.

### 6. Color and Turbidity

- There are no numeric criteria for color and turbidity. However, the standard dictates water bodies must be free from aesthetically objectionable conditions. A slight film, likely from bacteria, algae, or pollen, was observed at Blacks Nook during the 5/31/2017 sampling event (see Photograph A).

### 7. Taste and Odor

- No objectionable odors observed.

### 8. Oil and Grease

- No samples taken, but no visible oil and grease sheens observed.

**Little Fresh Pond (LFP)-** Not assessed as part of the 2014 Massachusetts Integrated List of Waters survey. Chl-*a* results were consistent with Carlson's trophic state index of a highly-productive, eutrophic and hypereutrophic pond (figure 2). Shoreline restoration, vegetated buffers, and a pretreatment swale and forebay system were completed in 2008. Specific conductance readings and sodium and chloride concentrations are consistently among the highest of the reservation ponds (table 1). The values for these parameters closely mirror those of Fresh Pond Reservoir, reflecting the hydrological connectivity via pipes and groundwater communication. No violations of Class B water quality standards were observed during the 2017-2018 study period.



**North Pond-** Not assessed as part of the 2014 Massachusetts Integrated List of Waters survey. During the growing season, this pond fills with floating and rooted aquatic plants. The 2017-2018 chl-*a* results were consistent with Carlson's TSI for a highly-productive, eutrophic and hypereutrophic pond (figure 2). North Pond had the highest average and median TSI readings and was the most eutrophic of the three ponds (figure 2).

#### 1. Dissolved Oxygen

- One violation of the Class B standard for dissolved oxygen was observed on 5/31/2017. CWD staff observed a film on the water which was likely attributable to bacteria or algal growth. It is possible that nutrient runoff from the golf course, warming water temperatures, and reduced shading from aquatic macrophytes due to being early in the growing season resulted in a spike in algae growth. Respiration of algae could account for the low DO.

Date	Time	Result
5/31/17	11:17 am	3.15 mg/L

- DO during the August 8/2/2017 sampling event was elevated (9.06 mg/L) even though the pond had more weed growth than in May (photos B and C). The August sampling event also had the lowest chl-*a* (9.93 mg/m<sup>3</sup>) and total phosphorus (TP) concentrations (0.046 mg/L<sup>1</sup>) of the 2017 reporting period at North Pond (table 1). In contrast, DO during the 2016 summer sampling event was much lower at only 0.29 mg/L and had a higher chl-*a* concentration (30.4 mg/m<sup>3</sup>), although the TP concentration was lower than in 2017 (see results below).

Comparison of 2016 and 2017 Summer Sampling Results at North Pond				
Date	Time	DO (mg/L)	Chl- <i>a</i> (mg/m <sup>3</sup> )	TP (mg/L)
7/27/2016	10:34:06 AM	0.29 mg/L	30.4	0.021
8/2/2017	10:56:09 AM	9.06 mg/L	9.93	0.046 mg/L

<sup>1</sup> Average of sample and duplicate sample TP result



2. Temperature

- No violations associated with warm-water fisheries were observed; temperature remained below 28.3 degrees C.

3. pH

- No violations observed;  $6.5 < \text{pH} < 8.3$ .

4. Bacteria

- No violations observed.

5. Solids

- There are no numeric standards for solids. Visual observations suggest that neither floating nor suspended solids were a source of impairment for the pond, with the exception of the excessive vegetation and turbidity during the summer months discussed below.

6. Color and Turbidity

- Eutrophic state and water clarity discourage swimming and boating; during the summer, North Pond becomes choked with aquatic vegetation and suspended organic matter.
- A slight film, likely from bacteria, algae, or pollen, was observed at North Pond during the 5/31/2017 sampling event (see Photograph B).
- Photographs C shows the dense aquatic vegetation in North Pond on 8/2/2017. Photograph D was taken after the growing season on 11/29/2017 when aquatic vegetation and suspended organic matter were less problematic.

7. Taste and Odor

- No objectionable odors observed.

8. Oil and Grease

- No samples taken, but no visible sheens observed.





**Photograph A: Blacks Nook surface from observation platform, 5/31/2017**





**Photograph B: North Pond looking south, 5/31/2017. Turbid water and algae or bacteria film were observed. Aquatic macrophyte growth was minimal compared to August (photograph C below).**







**Photograph C: North Pond sampling location looking southwest, 8/2/2017. Dense aquatic vegetation and suspended organic matter were present throughout the pond.**



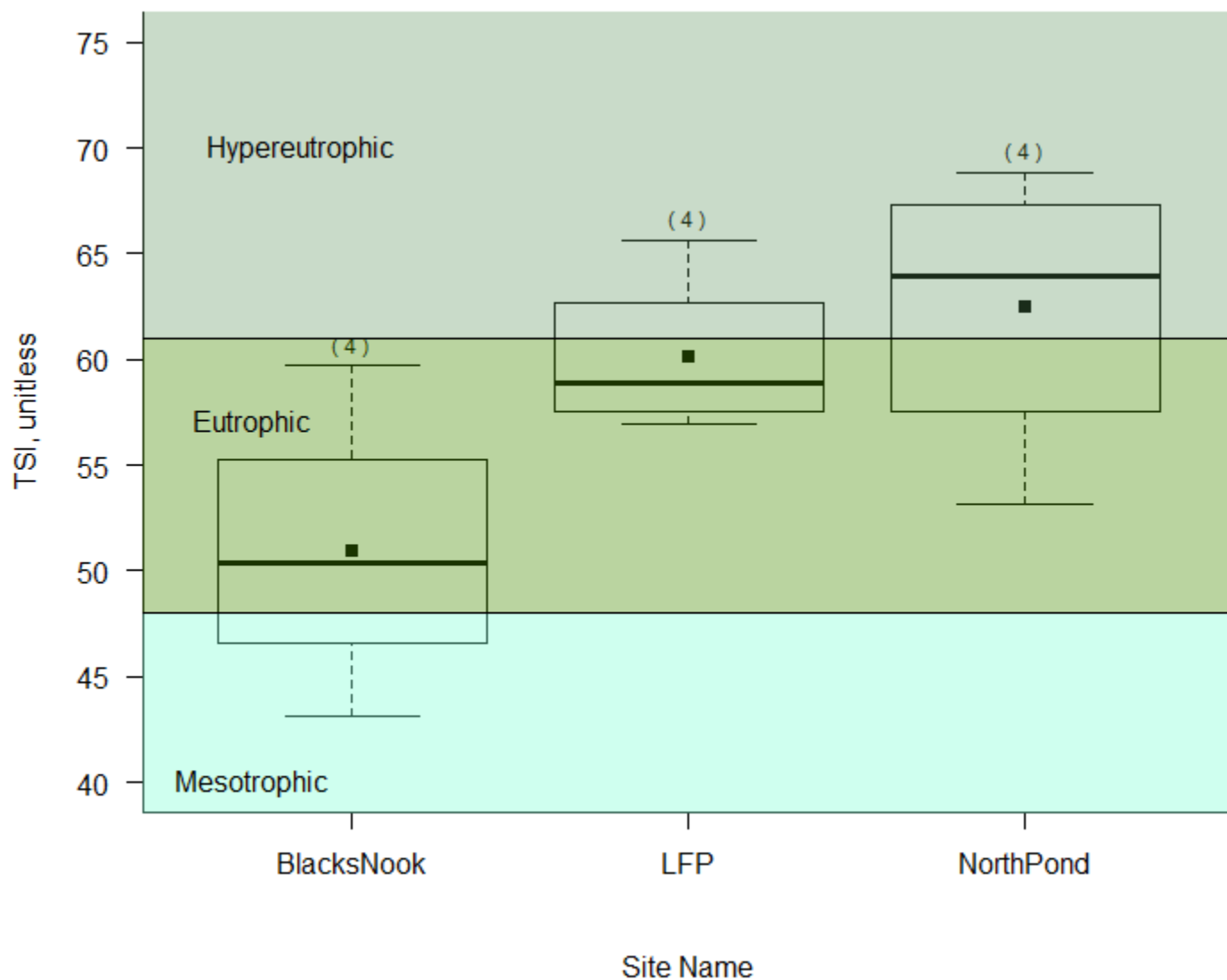
**Photograph D: View of North Pond sampling location looking southwest on 11/29/2017. The dense aquatic vegetation had considerably decreased.**



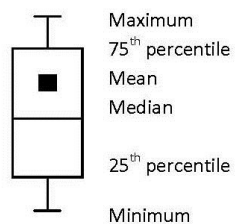




**Figure 2: Reservation Pond Trophic State Index from Chlorophyll-*a*, April 1, 2016 – March 31, 2017**



(3) Number of Measurements





# 2017 Fresh Pond Reservation Class B Waters

**Table 1: Water Quality Results**

Date	Site	Alkalinity (mg CaCO <sub>3</sub> /L)	Al (mg/L)	Ca (mg/L)	Cl (mg/L)	Chl- <i>a</i> (mg/m <sup>3</sup> )	Color (CU)	DO (mg/L)	<i>E. coli</i> (MPN/100 mL)	Fe (mg/L)	Lab pH	<i>In situ</i> probe pH	Mn (mg/L)	Na (mg/L)
5/31/2017	Blacks Nook	49	0.0102	19	25	3.82	28	7.94	15	0.84	7.38	7.38	0.06	11
5/31/2017	Blacks Nook	57	0.0018	20	25	3.37	26	7.94	7	0.77	7.36	7.38	0.06	12
5/31/2017	LFP	60	0.1009	35	145	35.7	42	7.32	152	1.12	7.08	7.28	0.49	80
5/31/2017	North Pond	85	0.0088	41	25	24.5	74	3.15	158	3.10	7.18	7.12	0.43	15
8/2/2017	Blacks Nook	51	0.0234	35	23	19.4	34	3.12	411	0.86	7.36	7.03	0.21	80
8/2/2017	LFP	66	0.1648	18	140	16.4	32	8.85	73	0.84	7.65	7.21	0.10	11
8/2/2017	North Pond	29	<0.0002	40	28	9.93	56	9.06	10	1.27	7.73	7.76	0.14	15
8/2/2017	North Pond	105	<0.0002	37	27	n/s	54	9.06	n/s	0.86	7.66	7.76	0.06	14
11/29/2017	Blacks Nook	55	0.0111	19	28	7.87	14	10.84	12	0.43	7.27	7.74	0.02	13
11/29/2017	LFP	52	0.1482	44	140	19.4	27	12.86	7	11.7	7.63	8.06	0.16	92
11/29/2017	North Pond	94	0.1052	37	29	36.7	72	8.51	10	2.18	7.26	7.62	0.31	15
11/29/2017	North Pond	98	0.1641	36	29	35.9	76	8.51	10	2.39	7.20	7.62	0.35	15
2/21/2018	Blacks Nook	42	0.0325	14	19	7.18	23	7.83	1	0.76	6.90	7.66	0.26	9
2/21/2018	LFP	43	0.0241	21	97	15.0	26	10.79	3	0.59	7.04	7.64	0.23	53
2/21/2018	LFP	44	0.0334	26	93	14.4	26	10.79	2	0.19	7.05	7.64	0.09	99
2/21/2018	North Pond	98	0.0074	33	24	49.4	88	18.79	4	3.32	6.85	7.41	0.77	13

Anomalous data are highlighted in red. n/s = not sampled



# 2017 Fresh Pond Reservation Class B Waters

**Table 1: Water Quality Results cont.**

Date	Site	NH <sub>3</sub> (mg/L)	NO <sub>3</sub> (mg/L)	Lab SpC (uS/cm)	<i>In situ</i> probe SpC (uS/cm)	Total Dissolved Solids (mg/L)	Water Temperature (degrees C)	TKN (mg/L)	Total Organic Carbon (mg/L)	Total Phosphorus (mg/L)	Turbidity (NTU)
5/31/2017	Blacks Nook	0.13	0.02	172	188	121	17.37	0.68	6.1	0.041	2.1
5/31/2017	Blacks Nook	0.12	0.02	166	188	121	17.37	0.72	5.9	0.043	2.2
5/31/2017	LFP	0.24	0.07	639	762	488	17.23	1.28	5	0.062	5.6
5/31/2017	North Pond	0.31	<0.005	300	317	203	16.74	1.31	15.3	0.075	7.8
8/2/2017	Blacks Nook	0.10	<0.005	172	189	121	24.22	0.77	5.1	0.061	5.0
8/2/2017	LFP	0.10	<0.005	365	626	401	25.93	0.77	5.9	0.052	4.9
8/2/2017	North Pond	0.17	<0.005	287	301	193	28.16	1.00	13.8	0.048	4.3
8/2/2017	North Pond	0.20	<0.005	288	301	193	28.16	1.09	13.9	0.045	4.2
11/29/2017	Blacks Nook	0.09	0.05	176	205	131	4.53	0.40	5.1	0.029	1.4
11/29/2017	LFP	0.09	<0.005	529	603	386	5.17	0.82	5.3	0.032	3.1
11/29/2017	North Pond	0.20	<0.005	267	295	189	5.54	1.10	14.7	0.067	4.0
11/29/2017	North Pond	0.17	<0.005	274	295	189	5.54	1.07	14.9	0.073	4.5
2/21/2018	Blacks Nook	0.05	<0.05	139	164	105	4.90	0.45	4.2	0.037	2.8
2/21/2018	LFP	0.09	<0.05	390	421	270	8.28	0.63	4.5	0.027	2.8
2/21/2018	LFP	0.13	<0.05	394	421	270	8.28	0.55	4.9	0.030	2.7
2/21/2018	North Pond	0.14	<0.05	266	298	191	6.12	0.96	12	0.111	6.6